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Surface Mining and Environmental Quality: An Economic Perspective

BY ALAN RANDALL AND ANGELOS PAGOULATOS*

Coal fueled the development of America from a rustic frontier society to a major industrial power in the 19th century. Although its relative importance continually declined throughout the present century as oil and natural gas became the major sources of energy for America, many observers expect coal to reassume its prominent position as a source of energy.¹ Production of coal peaked in 1972, but has remained high in later years. The trend toward the declining importance of coal has been reversed, and by 1974 coal contributed about 18 percent of the total energy consumed in that year.² In spite of this increase in output, the total number of mines is decreasing. The ones remaining, however, are becoming larger and more productive.³

Despite the recent slight decrease in total coal production, output of coal from surface mines has continued to increase, amounting to almost 50 percent of total United States coal production in 1974.⁴ In Appalachia, the hilly terrain imposes severe difficulties for surface mining, which accounts for only 37 percent of its coal output.⁵ The expansion of surface mining

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¹ The price of crude oil has increased due to the activity of the Organization of the Petroleum Exporting Countries (OPEC) which was formed in 1960 as a reaction to decreasing prices of crude petroleum and has become a cartel that sells a license to produce in order to keep prices above cost.

² Coal production for the United States in 1972 was 595.4 million short tons with Appalachia producing 374 million short tons. UNITED STATES DEPARTMENT OF THE INTERIOR, MINERALS YEARBOOK 1973, Vol. I, at 317-77 (1975). The average value of Appalachian coal was \$9.53 per ton in 1973. The average price of coal continued to increase in 1974 and appears to have declined from 1974 levels during 1975.

³ In 1973, there were 4,744 active coal mines in the United States, of which 4,400 were located in Appalachia. UNITED STATES DEPARTMENT OF THE INTERIOR, BUREAU OF MINES, MINERAL INDUSTRY SURVEYS, COAL—BITUMINOUS AND LIGNITE IN 1973 (1974).

⁴ *Id.*

⁵ *Id.*

is best explained by cost advantages, which stem in large part from the labor savings possible with surface mining operations.

Presently estimated coal reserves are about 3,200 billion tons, of which one-half has been positively identified and the remaining half is estimated to exist in areas which have not been explored and mapped. Up to the end of 1970, 36 billion tons had been mined. It is estimated that of the reserves currently identified, 390 billion tons could be recovered with current technology, of which 200 billion tons could be mined at 1973 costs.⁶

Coal mining contributes significantly to the gross national product and is a major employer in the United States.⁷ Moreover, its importance is likely to increase in the future as coal is substituted for relatively scarce sources of energy. While the coal mining industry is expected to expand more rapidly in the midwest and far west than in Appalachia, the Appalachian region will remain a major source of coal. It is also expected that surface mining will continue to increase in importance relative to underground mining.⁸

Although the coal mining industry has contributed to economic development and improved standards of living in America, it has not traditionally been associated with a high quality of life in the regions in which it operates.⁹ In recent years, as a result of the current demand for coal and improved mining technology, the social and environmental problems associated with the coal industry appear less severe.¹⁰ Nevertheless, in the coal producing regions of Appalachia, income and labor force participation rates remain substantially below the national

⁶ Risser, *The U.S. Energy Dilemma: The Gap Between Today's Requirements and Tomorrow's Potential*, 64 ENVIRONMENTAL GEOLOGY NOTES 39 (Illinois Geological Survey, 1973).

⁷ In 1973 the average number of men working daily in coal mining in the United States was 148,000 of which 120,000 were in Appalachia. Twenty-three percent of that total coal labor force were employed in surface mining. In Appalachia that figure was 18 percent. Average output per man per day in the United States was 11.7 tons for underground mines and 36.6 for surface mines. UNITED STATES DEPARTMENT OF THE INTERIOR, BUREAU OF MINES, MINERAL INDUSTRY SURVEYS, COAL—BITUMINOUS AND LIGNITE IN 1973 (1974).

⁸ Miernyk, *Coal and the Future of Appalachian Economy*, 9:2 APPALACHIA 29 (1975) [hereinafter cited as Miernyk].

⁹ See, e.g., M. BOWMAN and W. HAYNES, RESOURCES AND PEOPLE OF EASTERN KENTUCKY (1963), and H. CAUDILL, NIGHT COMES TO THE CUMBERLANDS (1962).

¹⁰ See Miernyk, *supra* note 8.

average.¹¹ In addition, government seems unable to provide services such as education and roads at the levels taken for granted in other parts of America,¹² and environmental problems, particularly water pollution, and the damage done to the land in the process of surface mining, are yet to be solved satisfactorily.¹³

Given the broad impact of the coal industry on the quality of life in the regions in which it operates, the focus of this article is quite narrow. We will consider only the surface mining industry and its impact on environmental quality, providing an economic perspective of the role of legislation and regulation in influencing the environmental performance of the industry.

I. THE LAW AND ECONOMIC PERFORMANCE

Legislation and regulation contribute to the total package of incentives which guide economic activity. By tracing the relationship between the structure of incentives and economic performance, it is possible to evaluate the role of legislation and regulation.

A. *Efficiency and Maximum Welfare*

There are two concepts helpful in evaluating economic performance: efficiency and maximum social welfare. The economic definition of efficiency includes the popular notion of least-cost production, that goods and services should be produced in the manner entailing the lowest possible cost, but is somewhat broader. An efficient economy also produces its goods and services in proportions consistent with the demands of consumers and distributes these goods and services among consumers in such a way that no one can improve his position through trading. Trading is useful for moving the economy toward efficiency but, once efficiency has been attained, no profitable trading opportunities remain. An economy is said to be efficient when it is so organized that no conceivable change

¹¹ U.S. BUREAU OF THE CENSUS, CHARACTERISTICS OF THE POPULATION, UNITED STATES SUMMARY (1970).

¹² See Miernyk, *supra* note 8.

¹³ *Id.*

can be made, no resources can be reallocated and no goods and services can be redistributed, to improve anyone's position without simultaneously worsening the position of someone else.

Obviously efficiency of production and distribution is a desirable state for any economy, even if it is a rather idealistic goal which may be approached under favorable circumstances but probably never achieved. However, even if efficiency were achieved, the economic problem would not necessarily be solved. The highest economic goal, maximum social welfare, requires not only efficiency but also that income, or purchasing power, be distributed in a manner consistent with society's preferences. Efficiency of production and distribution and an optimal or, at least, acceptable distribution of income are both valid economic goals which, because of their interrelationship, cannot be pursued independently.¹⁴

B. *Legal Rights and Efficiency*

A system of rights defines the proper relationships among individuals in a society and the penalties for violation of these proper relationships. Property rights are those rights which refer to the proper relationships among people with respect to the use of things. Most legislative and regulatory activity involves the definition, specification and enforcement of rights.

An imaginary society, wiping clean its whole slate of laws and institutions in order to start anew, would have a wide choice among the possible specifications of its system of rights. The distribution of income, wealth, and economic and political power is influenced by the specification of rights, and, in addition, resource allocation and the production and exchange of goods and services is much influenced by the way in which rights are specified. Since 1776, when Adam Smith published

¹⁴ For any given distribution of income, an efficient solution may be conceivable, and for each different distribution the efficient solution, if it exists, will be different. The solution to the economic problem requires the socially optimal distribution of income and the particular efficient pattern of resource allocation and commodity distribution consistent with that distribution. The reader must be cautioned, however, that no practicable method for determining society's distributional preferences has been found, while theorems purporting to show that it is impossible to determine societal preferences in a democratic manner have been proved. See K. ARROW, *SOCIAL CHOICE AND INDIVIDUAL VALUES* (1951). Thus, the notion of maximum social welfare, while conceptually valid, has proven operationally intractable.

The Wealth of Nations, the idea that unregulated private enterprise may work toward the general public welfare has had some currency. In the last 200 years, much of the intellectual activity of economists has been directed toward defining, with ever increasing rigor and precision, the conditions under which unregulated private activity may result in economic efficiency.

It is not impossible for a centrally planned economy to approach efficiency; but it requires expensive, time consuming, highly competent planning based on a wealth of detailed information and economic intelligence. The beauty of the private enterprise system is that under certain specific conditions it has an inherent tendency to generate efficient outcomes without need for the oversight of economic planners.¹⁵ Under these precise conditions, unregulated markets will function efficiently, private costs will equal social costs, and private economic activity will respond to incentives which direct it along socially beneficial lines. Where markets are noncompetitive and property rights are attenuated, inefficiency will result.

C. *Environmental Externalities*

One kind of inefficiency of great interest in the context of coal mining is externality, a situation in which the acts of one party influence the welfare of an affected party but the adverse or beneficial impact on the affected party does not enter the decisions of the acting party. In the case of external diseconomy, the externality has an adverse influence on the welfare of the affected party. Some of the private costs of the acting party are transferred to the affected party and hence private and social costs are not equal. The usual consequences of external diseconomy are that more than the efficient amount of damage is done to the affected parties, more than the efficient amount of the commodity associated with the external diseconomy is

¹⁵ The primary requisite conditions are as follows:

1. Markets must be competitive. No individual buyer or seller should be able to materially influence prices and the marketing activities themselves should be performed in a competitive fashion.
2. Property rights to resources and commodities must be nonattenuated. Nonattenuated property rights are: a) Completely specified, to provide an effective information system; b) exclusive, so that all rewards and penalties from an act accrue to the actor; c) enforced, since an unenforced right is without effect; and d) transferable, so that property rights may gravitate to their highest use.

produced and consumed, and the price of the associated commodity is lower than the efficient price.

Unreasonable external diseconomy is permitted to occur when the rights of the parties are not properly specified and enforced. Those external diseconomies which are most significant in terms of the amount of damage done and the extent of the deviation from efficiency tend to be those where it is not traditional practice, or it is physically difficult or impossible, to establish private rights over affected resources. For example, trespass is a problem which is relatively easy to control since courts have firmly established the rights of private owners of real property to exclude intruders. But air pollution has proven almost impossible for private law to control since exclusive rights to air have not been established and would be difficult to establish and enforce due to the physical characteristics of air.¹⁶

The environmental impact of coal mining can be conceptualized in these terms. Where mineral rights are dominant to surface rights, and where the rights to clean air and water, natural ecosystems, and aesthetically pleasing landscapes are unspecified or nonexclusive, coal mining operators are in a position to transfer their costs to others. Where coal operators may use the waterways free of charge for waste disposal, and where those rights to environmental quality which are vested in the general public remain unenforced, the process of transferring private costs to the public continues unimpeded.

D. *Internalization of Externalities*

Internalization is the name given to the process by which an external diseconomy is returned to efficiency.¹⁷ Where the establishment of nonattenuated property rights is a simple

¹⁶ See, e.g., *Bove v. Donner-Hanna Coke Corp.*, 258 N.Y.S. 229 (App. Div. 1932); Coase, *The Problem of Social Cost*, 3 J. LAW & Eco. 1 (1960).

¹⁷ Complete internalization of an externality eliminates the source of inefficiency and, if the economy is otherwise efficient, results in efficiency. It cannot be overemphasized that complete internalization of an externality such as environmental damage will usually reduce the extent of the damage but not eliminate it completely. Distasteful as it may seem to the dedicated environmentalist, there is some efficient amount of environmental damage; too little damage and too much damage are both inefficient. See Mishan, *What is the Optimal Level of Pollution*, 82 J. Pol. Eco. 1278 (1974).

matter and is not contrary to the physical nature of the resource concerned or the ethical and moral norms of society, this is the simplest approach. Then, private negotiations among the involved parties will tend to bring about an efficient solution.¹⁸

Where it is difficult or impossible to establish exclusive private property rights over the affected resources such as air, water, and landscape aesthetics, internalization must proceed through the exercise of governmental power, usually the police power or the power to tax. The use of the police power involves enforcement of some collective property rights in the name of the public welfare, while the power to tax works to achieve internalization through the price system.

Regulation, by exercise of the police power, limits private property rights and expands the rights of the collective by prohibiting acts which result in external diseconomies, or constraining them within acceptable limits, for example by setting pollution emissions standards. Since regulation increases the costs faced by the parts regulated, providing the incentive for violation, procedures for detection of violations and assessment of penalties must be established. The assessment of taxes or charges on external diseconomies, as in the case of a charge per unit of polluting emissions, is intended to confront the acting party (the polluter) with the social costs of his actions, and thus encourage internalization through the equalization of private and social costs.

Each of these general methods of solving externality problems has its advantages and its difficulties.¹⁹ The assessment of per unit charges on external diseconomies has gained much favor among economists. Advantages are that enforcement can be made routine, since it involves only the monitoring of damage and the collection of the charge; and that the charge provides incentive for internalization while leaving the acting party free to determine the least costly method of controlling or ameliorating the damage. Where damage is not com-

¹⁸ See Coase, *The Problem of Social Cost*, 3 J. LAW & Econ. 1 (1960). In the subsequent literature discussing the issues first raised by Coase, the conditions under which this type of market solution can be successful were defined. See Randall, *Coasian Externality Theory in a Policy Context*, 14 NAT. RESOURCES J. 35 (1974).

¹⁹ See A. FREEMAN, *THE ECONOMICS OF POLLUTION CONTROL AND ENVIRONMENTAL QUALITY* (1971).

pletely eliminated, the charge paid can be viewed as compensation from the acting party to the general public for damage caused. Several difficulties are encountered in using the method of per unit charges for damage. Substantial research is needed to determine the proper amount of the charge. For efficiency, the per unit charge should be equal to the dollar value of the damage caused per unit of externality. Also charge systems encounter political opposition from the creators of external diseconomies, who see them as expensive to themselves, and from legislators and administrators who are more comfortable with police power regulation.²⁰

Regulation is often politically acceptable, perhaps because it is easily understood. A simple rule of thumb is established: damage must be kept within prescribed bounds, and it is a violation of the law to exceed those bounds. However, regulations are likely to be inefficient for several reasons. Standards are nontransferable, hence efficiency can only be achieved with standards as a result of perfect planning. The standard set should coincide with the efficient level of internalization. Yet, substantial information is needed to calculate that level, and the optimum standard, once determined, must survive attempts at modification in the political, administrative, and judicial processes. Standards tend to be inflexible, while the efficient level of internalization may change over time as economic conditions change and new techniques of controlling and ameliorating damage are introduced. Regulations which mandate or subsidize the use of particular methods of reducing damage are especially inefficient since they discourage the development and implementation of alternative and perhaps superior techniques of damage control. Finally, enforcement of standards has tended in practice to be haphazard and sometimes less than enthusiastic. Enforcement agencies have been reluctant to assess penalties commensurate with the damage caused by violation, and variances and extensions for compliance are often granted.²¹

²⁰ *Id.* See Baumol, *On Taxation and the Control of Externalities: Reply*, 54 AM. ECO. R. 412 (1974); Plott, *Externalities and Corrective Taxes*, 33 ECONOMICA 84 (1966); Thompson and Batchelder, *On Taxation and the Control of Externalities*, 58 AMER. ECO. R. 466 (1974).

²¹ See FREEMAN, *supra* note 19.

E. *Summary*

The law, by specifying the proper relationships among individuals in a society and the penalties for violation of these relationships, provides a substantial part of the structure of incentives which guides the functioning of the economy. Under certain rather precise conditions, an unregulated economy will achieve efficiency and, in the best of all economic worlds, an efficient solution consistent with maximum social welfare is conceivable. In the real world, efficiency is not achieved due to noncompetitive influences and inadequacies in the laws which define rights, and, in particular, property rights.

The adverse environmental impact of coal mining may be diagnosed as externalities, where externality is one specific form of inefficiency. Each method of internalization has its advantages and its difficulties. Transaction costs, the costs of making and enforcing decisions,²² are an important consideration in selecting the appropriate legal mechanism for solving externality problems. In very general terms, a good system of legal rights would have the following properties: it would encourage efficient or relatively efficient outcomes, keep transaction costs within acceptable bounds and have a socially acceptable distributive impact. Clearly, we are seeking the best of the available imperfect solutions.

While the regulatory approach has its advantages and a long tradition of political acceptance, it has potential economic disadvantages. Legal alternatives to regulation should be seriously considered, and, where regulation appears to be the most fruitful approach, care should be taken to draft regulations which are more, rather than less, conducive to economic efficiency.

II. ECONOMIC ANALYSIS AND ENVIRONMENTAL QUALITY

Quantitative economic analysis is essential to provide an adequate amount of information to guide social policy with respect to the environment.

²² Transaction costs include the private and public costs of decision making, as well as the costs encountered in using the legislative, administrative, and judicial processes.

A. *Benefits and Costs of Environmental Policies*

Efficient internalization of environmental externalities requires that the damage be reduced to that point where the benefits from an additional step are just equal to the costs of that step, given that total benefits exceed total costs. The costs of environmental improvements are simple to calculate, provided the necessary engineering and biological data are available. However, measuring the benefits of environmental improvements is difficult. One analysis equates the benefits of a certain level of environmental improvement with the costs which would have been caused by the damage if it had been allowed to continue, thus defining benefits from environmental improvements in terms of cost avoidance.²³

Environment refers to the totality of natural resources including the intricate interrelationships among living and non-living things which constitute ecosystems and biomes. Environmental damage occurs when waste from one resource use affects the quantity and quality of a resource supply so as to preclude the use of that resource, increase costs, or reduce the benefits of a later use of the resource. Not all changes in resource quality are damaging, however. Some changes may be beneficial to later uses.

Environmental quality changes are economically relevant when they affect later uses to which resources may be put to meet the future demands of people. In ascribing dollar values to the costs of environmental damage, later uses of affected resources must be traced and dollar values ascribed to the preclusion of later uses, losses in productivity of later uses, and increased costs of treatment to improve or restore the quality of the resource for later uses.

Where changes in resource quality are irreversible, such changes, even if they may not seem damaging at the time they take place, may preclude options for resource use which may become feasible in the future due to technological developments and changes in demand. Foreclosure of future options must be evaluated as an opportunity cost of achieving present

²³ In A. KNEESE AND B. BOWER, *MANAGING WATER QUALITY: ECONOMICS, TECHNOLOGY AND INSTITUTIONS* (1967) the authors use a similar approach.

goals.²⁴ While it is often difficult to place dollar values on these types of foreclosed options, it is appropriate to view irreversible environmental damage with a good deal of suspicion.

Quantitative economic evaluation of the benefits of avoiding environmental damage is most difficult when the later uses affected are of a nonmarket nature. Aesthetic and recreational uses fall into this category, as does the social disruption which accompanies some types of resource use. Progress in developing techniques for these types of analyses is being made and some studies have been completed which appear accurate and reliable.²⁵ Nevertheless, the technology of economic analysis remains underdeveloped in these directions.

B. *The Economic Impact of Environmental Policies*

As we have indicated, where an external diseconomy exists, the price of the commodity associated with the externality will be lower than the efficient price, and the quantity of the commodity produced and consumed will be more than the efficient amount. After a society has had years to accustom itself to an externality, the process of internalization, when it eventually occurs, will, to some degree, reduce production and increase the price of the associated commodity. Thus, internalization to return the situation to efficiency may seem expensive and perhaps economically disruptive. Proper planning of environmental policy should include consideration and analysis of these factors.

III. SURFACE MINING AND THE ENVIRONMENT

Already more than a million acres in Appalachia have been surface mined, and it is estimated that 31 million acres in Appalachia overlie reserves of coal.²⁶ Thus, surface mining

²⁴ Opportunity costs of a decision to use a resource in a certain way are defined as the net value of alternatives which are foregone as a result of that decision.

²⁵ See, e.g., M. Clawson, *Methods of Measuring the Demand for and Value of Outdoor Recreation* (Reprint 10, Resources for the Future, 1959); Davis, *Recreation Planning as an Economic Problem*, 3 NATURAL RESOURCES J. 239 (1963); Freeman, *On Estimating Air Pollution Control Benefits from Land Value Studies*, 1 J. ENVIR. ECO. MGT. 74 (1974); and Randall, Ives, and Eastman, *Bidding Games for Valuation of Aesthetic Environmental Improvements*, 1 J. ENVIR. ECO. MGT. 132 (1974).

²⁶ W. Curtis, *Strip Mining, Erosion and Sedimentation* (paper presented to American Society of Agricultural Engineers, #70-222, July 7-10, 1970).

is a significant form of land use in Appalachia as well as a major source of coal. In Appalachian Kentucky, permits to strip more than 40,000 acres were issued in a single year, 1974.²⁷

Surface mining of coal generates environmental damage in several ways. The disturbance of land and its vegetative cover and the removal and deposition of overburden may increase the amount of run-off following rain and the concentration of soil particles suspended in the run-off. The frequency and severity of floods may be increased and water quality may be adversely affected by increased sediment and concentration of harmful chemicals in the run-off. Surface mining may result in increased incidence of erosion and slides, reducing the land's productivity in agricultural and forest uses and perhaps destroying productive land and buildings. The process of disturbing the land surface and the removal and deposition of overburden destroys natural ecosystems and the aesthetic quality of the landscape, diminishing its value for purposes in which aesthetic characteristics are important.

Clearly, where surface mining is uncontrolled and its negative environmental impact unmitigated, external diseconomies exist. Many of the true costs of surface mining are transferred from mining operators and consumers of coal to the affected public. Later uses of the land resources which are diminished in value include agriculture; forestry; extraction of minerals; recreation; transportation; residential, commercial and industrial uses; and the maintenance of land-based ecosystems. The water resource has many of the same functions in addition to household and industrial uses, navigation, recreation and the support of water based ecosystems.

The severity of environmental impact depends on the extent of surface mining in the affected region, the technique of surface mining used and the methods of handling overburden and disposal of wastes, the depth of overburden, the slope of the land, and the climatic and geological features of the region. Thus, the economic value of the damage associated with surface mining will vary among mining sites, as well as among the different mining regions of the country.

²⁷ CENTER FOR SCIENCE IN THE PUBLIC INTEREST, ENFORCEMENT OF STRIP MINING LAWS 23 (Washington, 1975).

A. *The Costs of Reclamation*

Researchers at Oak Ridge National Laboratory²⁸ have estimated the cost of various reclamation procedures in the Appalachian coal fields. At the risk of oversimplification, we will attempt to summarize their preliminary estimates. Average operating costs estimated at 1972 prices for basic reclamation, defined as spoil stabilization sufficient to prevent off-site damages from groundslides, erosion, and water run-off, were in the range of 25 to 60 cents per ton of coal produced. Full reclamation, defined as basic reclamation plus the return of the land to a state of useful productivity and restoration and enhancement of landscape aesthetics, would cost from 65 to 95 cents per ton.²⁹ By contrast, reclamation costs for surface mines in North Dakota were estimated to fall in the range of 4 to 11 cents per ton of coal mined.³⁰

B. *Benefits of Reclamation*

In order to determine the economic efficiency of reclamation, it is necessary to know both its benefits and its costs. To justify reclamation, in the economic sense, benefits should exceed costs. While the costs of reclamation reported in North Dakota are only a few cents per ton of coal mined, they amount to around \$800 per acre of surface mined land. Part of this total cost is attributable to the costs of preventing off-site damages, but the greater proportion is for returning the land to an acceptable condition. With land in that region selling at \$50

²⁸ Hereinafter referred to as ORNL.

²⁹ R. Carlsmith, R. Spore, and E. Nephew, Systems Studies of Coal Production-Progress Report, Oak Ridge National Laboratory (Dec. 1974). In this report, the slope of the terrain, maximum high wall height and mining method were variables which influenced reclamation costs. Reclamation costs were also related to total annual regional output. If output were to be substantially increased in the shortrun, this might require mining in more difficult terrain and mining shallower seams underlying deeper overburden. Thus, reclamation costs might increase (and would in fact increase substantially in Northern and Southern Appalachia but not in Central Appalachia) if total output of coal were substantially expanded.

³⁰ Hertzgaard and Leistritz, *Environmental Impact of Strip Mining: The Economic and Social Viewpoints*, in SOME ENVIRONMENTAL ASPECTS OF STRIP MINING IN NORTH DAKOTA 73 (M. Wali ed.) (Educ. Ser. 5, North Dakota Geological Survey, Grand Forks, North Dakota, 1973).

to \$150 per acre,³¹ the economic justification for reclamation would require that the discounted future value of the land be several times the value indicated by the current market price for agricultural uses. This is not impossible, since the market system tends to be somewhat myopic and materially oriented. Future considerations tend to be heavily discounted, with aesthetic and social values subordinated to those values more easily measured in dollars.

In Appalachia, several studies to quantify as completely as possible the economic benefits from reclamation are now in progress.³² Some preliminary results have been obtained at the University of Tennessee.³³ In five case study watersheds, the economic value of damage due to surface mining, and hence the benefits from abatement of that damage, were estimated to be from \$.60 to \$1.40 in 1973 dollars, per ton of coal mined. Aesthetic and social considerations were not fully incorporated into these tentative estimates, so they may be regarded as lower bounds on the value of the benefits from full reclamation. This range of benefits overlaps to some extent the costs of reclamation estimated by the ORNL researchers.³⁴ Thus, it seems that the benefits of full reclamation exceed the costs in at least some cases.³⁵ Further refinements in estimating the economic value of social and aesthetic benefits from reclamation may result in upward revisions of the benefits.

C. *The Economic Impact of Reclamation Requirements*

The White House, in justifying the Presidential veto of the 1975 surface mining bill,³⁶ claimed that the provisions of this

³¹ *Id.*

³² One study is being made under the direction of the authors and their colleagues.

³³ Bohm, Moore and Schmidt-Bleek, *Benefits and Costs of Surface Mine Reclamation in Appalachia*, in *ENERGY AND MAN: TECHNOLOGICAL AND SOCIAL ASPECTS OF ENERGY*, 441-447 (M. Morgan ed. 1975).

³⁴ *Supra* note 29.

³⁵ In the Tennessee case studies, *supra* note 33, the estimates of reclamation costs were higher than the estimates in the ORNL study, *supra*, note 29. This is because the Tennessee case studies were all of orphan mines. Reclamation is less expensive when proper preparation for reclamation is undertaken during mining. The Tennessee researchers concluded that, in their case studies, the benefits they were able to measure recovered a substantial proportion of the estimated costs of reclamation but did not exceed the costs.

³⁶ H.R. 25, 94th Cong., 1st Sess. (1975).

bill would substantially reduce coal output and eliminate 36,000 jobs.³⁷ However, ORNL researchers estimate that full reclamation and the proposed \$0.35 per ton tax to finance reclamation of abandoned surface mines would reduce Appalachian coal output by 7.5 million tons, 2 percent of current Appalachian output, raise the average price of coal by \$0.35 per ton and result in the direct and indirect loss of no more than 932 jobs in Appalachia.³⁸ This study was based on 1972 prices. Considering that coal prices increased dramatically in 1973 and 1974 and, in spite of declines during 1975, remain well above 1972 levels,³⁹ it is likely that the present impact of reclamation laws on coal output and employment may be less, rather than more, substantial than suggested by the ORNL study. The cost estimates for reclamation in North Dakota⁴⁰ suggest that reclamation requirements would have only a small impact on coal output in the Upper Great Plains.

These rather tentative studies suggest that much of the environmental damage from the surface mining of coal can be eliminated or substantially reduced without major cost increases. The predicted price increases and reductions in output and coal-related employment are relatively small. On this basis, it can be argued that strong reclamation requirements are well within the tolerance of the economy.

D. *Summary of the Available Economic Information*

The available economic data is tentative and inconclusive at this time. However, some data suggests that reclamation requirements are unlikely to reduce the output of coal and the employment generated by the coal extraction industry substantially.⁴¹ In many situations, the benefits from full reclamation may exceed the costs. In other cases, basic reclamation at least may be economically justified. In cases where reclamation is too costly, the public must decide whether surface mining should be permitted. Since external diseconomies are occurring

³⁷ Louisville Courier-Journal May 20, 1975 at 20, sec. A.

³⁸ Lin, Spore, and Nephew, *Land Reclamation and Strip Mined Coal Production in Appalachia*, J. ENVIR. ECON. MGT. (1976).

³⁹ *Supra* note 2.

⁴⁰ *Supra* note 30 and accompanying text.

⁴¹ *Supra* note 38 and accompanying text.

in which environmental costs are transferred from coal operators to the public, the operators may reasonably be confronted with these costs and the public compensated for the damage it suffers.

IV. LEGISLATION AND REGULATIONS AFFECTING SURFACE MINING

With the above considerations in mind, it is possible to discuss the existing legal and regulatory framework within which the surface mining industry operates, to consider the economic implications of the existing framework, and to make some tentative suggestions as to future legal change.

A. *Private Law*

Coal mining, along with all other types of economic activity, is subject to the provisions of private law. Property law offers some protection to holders of rights to the surface estate and the mineral estate.⁴² However, Kentucky still recognizes the so-called "broad form deed" which assigns to the mineral right holder a set of rights which are dominant to those of the surface right holder.⁴³ Minerals may be extracted without the permission of the surface right holder, who may recover damages caused in the process of mining only under extremely limited circumstances.⁴⁴ Courts in other states where broad form deeds were prevalent have substantially weakened and circumscribed these deeds, reassigning some rights to the surface estate.⁴⁵

⁴² See generally 3 AMERICAN LAW OF MINING §§ 15-18 (1969); F. TRELEASE, H. BLOOMENTHAL & J. GERAUD, CASES AND MATERIALS ON NATURAL RESOURCES 858-1054 (1965); 54 AM. JUR. 2d, *Mines and Minerals* §§ 102-147 (1971).

⁴³ *Schneider, Strip Mining in Kentucky*, 59 Ky. L.J. 653-57 (1970-71); Note, *Kentucky's Experience with the Broad Form Deed*, 63 Ky. L.J. 107 (1974-75). The broad form deed was again upheld in *Commerce Union Bank v. Kinkade*, No. 73-539 (Ky., May 28, 1976). Concurring opinions by Justice Stevenson and Chief Justice Reed however, indicated a willingness to reconsider *Buchanon v. Watson*, 290 S.W.2d 40 (Ky. 1956) at least prospectively. It is upon *Buchanon* that much of Kentucky's broad form deed law rests.

⁴⁴ E.g., *Martin v. Kentucky Oak Mining Co.*, 429 S.W.2d 395 (Ky. 1968); *Blue Diamond Coal Co. v. Neace*, 337 S.W.2d 725 (Ky. 1960); *Buchanon v. Watson*, 290 S.W.2d 40 (Ky. 1956).

⁴⁵ Note, *Construction of Deeds Granting the Right to Strip Mine*, 40 U. CIN. L. REV. 304 (1971); *Rocky Mountain Fuel Co. v. Heflin*, 366 P.2d 577 (Colo. 1961); *Franklin v. Callicoat*, 119 N.E.2d 688 (Ohio C.P. 1954); *Stewart v. Chernicky*, 266 A.2d 259

In principle, nuisance law allows a land owner to seek either injunctive relief or recovery of damages where the actions of another land owner unreasonably interfere with the use and enjoyment of his property.⁴⁶ This aspect of private law has had limited effectiveness in controlling the results of surface mining, however, as a result of judicial interpretation and the pervasive influence of the broad form deed.⁴⁷

Conceivably, a riparian water law could be interpreted so as to define stream pollution resulting from surface mining as an unreasonable use, thus permitting a riparian user to seek injunctive relief for damages.⁴⁸ However, this avenue has been of limited effectiveness, because strict standards of proof of causation are applied and joinder of multiple parties is often difficult.⁴⁹

In summary, the historic performance of the surface mining industry has been such as to suggest that private law, as judicially interpreted, has not been adequate to control the externalities created by the industry. Thus, we turn to an examination of laws and regulations enacted to control surface mining.

B. Regulation of Surface Mining

Most states in which surface mining occurs have by now enacted legislation controlling surface mining and requiring some degree of reclamation.⁵⁰ Surface mining statutes com-

(Pa. 1970); *Campbell v. Campbell*, 199 S.W.2d 931 (Tenn. Ct. App. 1946); *Oresta v. Romano Bros.*, 73 S.E.2d 622 (W. Va. 1952).

⁴⁶ W. PROSSER, *HANDBOOK ON THE LAW OF TORTS* §§ 89-90 (4th ed. 1971); Comment, *Nuisance—Reasonable Use*, 50 Ky. L.J. 104 (1961-62).

⁴⁷ *Kentland-Elkhorn Coal Co. v. Charles*, 514 S.W.2d 659 (Ky. 1974); *Tolliver v. Pittsburgh-Consolidation Coal Co.*, 290 S.W.2d 471 (Ky. 1956) (overruled by *Kentland*); see also Ausness, *Kentucky Law Survey: Torts*, 63 Ky. L.J. 753, 772-75 (1974-75).

⁴⁸ *Pennsylvania R.R. v. Sagamore Coal Co.*, 126 A. 386 (Pa. 1924), *cert. denied* 267 U.S. 592 (1925); 5 R. POWELL, *THE LAW OF REAL PROPERTY* ¶ 716 (1975); Maloney, *Judicial Protection of the Environment: A New Role for Common-Law Remedies*, 25 VAND. L. REV. 145, 151-52 (1972).

⁴⁹ Hines, *Nor any Drop to Drink: Public Regulation of Water Quality* 52 IOWA L. REV. 186, 196-201 (1966).

⁵⁰ E.g., OHIO REV. CODE ANN. §§ 1513.01-.99 (page 1968), *as amended*, (Supp. 1975); PA. STAT. ANN. tit. 52, §§ 1396.1-.20 (1966), *as amended* (Supp. 1975); TENN. CODE ANN. §§ 58-1539 to 1564 (Supp. 1975); W. VA. CODE ANN. §§ 20-6-1 to 31 (1973), *as amended*, (Supp. 1975).

monly have some or all of the following features: permits for surface mining must be obtained from an agency of the state; a permit fee is collected; some degree of reclamation is required; the operator must post a bond which is recoverable following satisfactory reclamation; and operators who have a history of violations, usually failure to perform satisfactory reclamation, may be denied permits.⁵¹

The current Kentucky legislation⁵² has all of these features. The permit fee is \$150 plus \$35 for each acre, or fraction thereof, to be mined.⁵³ Permit applications must be accompanied by substantial documentation indicating the natural and man-made environmental features which may be affected by surface mining.⁵⁴ Permits may be denied on several grounds. Important grounds for denial include a finding that reclamation requirements will not be observed or that reclamation and prevention of off-site damage is infeasible,⁵⁵ and that the permit applicant has a history of noncompliance with surface mining regulations.⁵⁶ Areas to be mined may be deleted if certain types of private and public property will be threatened.⁵⁷ Set-back provisions apply to surface mines in the vicinity of roads, streams, and lakes.⁵⁸ A bond of not less than \$500 and not more than \$3,000 per acre and not less than a total of \$5,000 must be posted.⁵⁹ All but \$300 per acre will be returned after backfilling, grading, and soil stabilization has been completed as required.⁶⁰ The remainder will be returned after planting and revegetation.⁶¹ Backfilling requirements are related to the type of terrain and method of mining. In the case of contour mining on steep slopes, up to 40 percent of the overburden may be placed beyond the solid bench and pushed down the slope.⁶²

⁵¹ Note, *Strip Mine Reclamation Regulation*, 39 Mo. L. REV. 429 (1974).

⁵² KY. REV. STAT. §§ 350.010-.990 (1971), as amended, (Supp. 1974) [hereinafter cited as KRS].

⁵³ KRS § 350.060 (9).

⁵⁴ KRS § 350.060(2)-(4).

⁵⁵ KRS § 350.085(1)-(2).

⁵⁶ KRS § 350.130(3).

⁵⁷ KRS § 350.085(3).

⁵⁸ KRS § 350.085(4).

⁵⁹ KRS § 350.151(2).

⁶⁰ KRS § 350.093(6).

⁶¹ *Id.*

⁶² KRS § 350.093(2)(h).

During mining, steps must be taken to prevent slides and water pollution due to sediment and acid run-off.

C. *Regulation of Water Quality*

The Water Pollution Control Act amendments⁶³ provide a strong regulatory approach to the control of discharge from point sources into navigable waterways and their nonnavigable tributaries.⁶⁴ The discretion of states to set standards is limited, and enforcement is a federal responsibility which may be delegated to states which meet certain requirements.⁶⁵ It seems likely that, when the regulations for Kentucky receive approval,⁶⁶ the 1972 federal act will require that run-off from surface mines into streams and tributaries be intercepted and held in holding or settling ponds. Discharge from holding ponds will probably require a permit. The 1972 Act also enables the regulation of water pollution from nonpoint sources.⁶⁷ It seems likely that, when regulations are eventually approved, run-off from surface mines will be included among the nonpoint sources regulated.

D. *An Assessment from an Economic Perspective*

Broad form mineral deeds were, for the most part, originally sold in unequal exchange between well-informed mineral rights buyers and poor and ignorant mountaineer land owners, half a century or more ago.⁶⁸ The sellers could not reasonably have been expected to foresee that surface mining methods of extraction would be developed and that the sale of mineral rights under the broad form deed arrangements would leave

⁶³ 33 U.S.C.A. § 1251 et seq. (Supp. 1976).

⁶⁴ See generally 33 U.S.C.A. §§ 1311-1319 (Supp. 1976); Keppler, *Mining and the FWPCA of 1972*, 20 ROCKY MOUNT. L. INST. 501 (1975).

⁶⁵ 33 U.S.C.A. § 1342 (Supp. 1976). See Arnold, *Effluent Limitations and NPDES: Federal and State Implementation of the FWPCA of 1972*, 15 B.C. IND. & COM. L. REV. 767 (1974).

⁶⁶ Kentucky's water quality regulations under the 1972 Act do not yet have the approval of EPA or the Attorney-General of Kentucky in spite of the expenditure of considerable effort in the regulatory, political, and judicial areas. See D. R. Stevens, *Another Try for Water Pollution Rules*, Louisville Courier-Journal, January 25, 1976, at 6, sec. D.

⁶⁷ 33 U.S.C.A. § 1311 (Supp. 1976); 33 U.S.C.A. § 1362 (12) (Supp. 1976).

⁶⁸ See Note, *Kentucky's Experience with the Broad Form Deed*, 63 KY. L.J. 107, 114 (1974-75).

their heirs without power to prevent surface mining or gain compensation for damage caused by surface mining.⁶⁹ Because of this, an argument based on the concept of economic equity can be made in favor of some reassignment of rights to the surface estate. Further, without modification of mineral rights under the broad form deed, the potential of property and nuisance law to control externality and thus promote economic efficiency is severely limited, and approaches based on the police powers and the power to tax are essential.

From an economic perspective, the current Kentucky legislation represents a reasonable, if imperfect, attempt at balancing the needs for energy production and environmental protection. However, concerns have been expressed as to the effectiveness of enforcement.⁷⁰ Indicators of effective enforcement may be the rate of permit denials and bond forfeiture.⁷¹ Since mining and reclamation take several years, it is too soon to make meaningful observations about bond forfeiture. Some observers are concerned, however, that the rate of permit denial and revocation has been rather low.⁷² At this time, we are confined to making the observation that the effectiveness of existing Kentucky regulations is dependent on careful inspection, monitoring, and enforcement.

Those federal surface mining bills which have recently been passed by Congress but vetoed by the President are not stricter than the Kentucky legislation in their reclamation provisions. However, they would set minimum standards for all states, and thus eliminate the possible temptation for some states to attract investment and employment in surface mining by enacting lenient surface mining regulations or enforcing the regulations in a lenient manner. They have included a tax of 35 cents per ton of surface mined coal and 10 cents per ton of deep mined coal to be collected and used for reclamation of

⁶⁹ Arguments along these lines have persuaded judges in many Appalachian states, but not in Kentucky, to limit the rights of the mineral estate under the broad form deed.

⁷⁰ The CSPI Study, *ENFORCEMENT OF STRIP MINING LAWS*, *supra* note 27, has identified substantial deficiencies in the enforcement of surface mining regulations in Kentucky. Louisville Courier-Journal, November 10, 1975, at 18, sec. A.

⁷¹ However, it must be noted that bond forfeiture would be unnecessary if all operators were in full compliance.

⁷² See *supra* note 70.

abandoned surface mining sites.⁷³ The major impact of a federal bill on surface mining in Kentucky may be stricter enforcement, if in fact federal supervision would lead to stricter enforcement.

In the light of our earlier discussion of economic efficiency and methods for internalization of external diseconomies, it may be appropriate to consider alternative institutional methods of controlling environmental damage from surface mining. Privately negotiated solutions are unlikely because much of the concern is for the protection of water quality and the aesthetic qualities of the landscape, and such solutions have been relatively ineffective in these settings.⁷⁴ The methods of charges or standards are more appropriate. Current Kentucky regulations have some elements of both charges and standards since reclamation requirements constitute a standard, and the possibility of bond forfeiture can be interpreted as a charge for creating damage.

We suggest that as more economic information becomes available about the benefits from surface mining control and reclamation in various types of environments, the bonding requirements become more flexible and thus more nearly approach a charge system. When our economic knowledge advances to the point that we can make good estimates of the value of environmental damages as related to the degree of reclamation undertaken in each type of environment mined, the total bond can be equated with the total value of damage when no reclamation and damage prevention efforts are undertaken.⁷⁵ A schedule relating the performance of various reclamation and damage prevention procedures with the return of various proportions of the total bond would be established. Rational mining operators would control damages and reclaim the land up to the point where the next step in reclamation would cost more than the scheduled amount of the bond to be

⁷³ The ORNL study, *supra* note 38, indicates that this requirement would have only a small impact on output and employment in the surface mining industry in Appalachia.

⁷⁴ See Randall, *Coasian Externality Theory in a Policy Context*, 14 NAT. RESOURCES J. 35 (1974).

⁷⁵ The existing studies *supra* notes 29, 35, and 38 suggest that current bonds in Kentucky, which are often set at the minimum rate of \$500 per acre, are not sufficiently high to cover the value of damages generated as the total cost of reclamation.

returned. Where full reclamation is very expensive, only partial reclamation would be performed; where reclamation is less costly, full reclamation would be completed. Where less than full reclamation is performed, the proportion of the bond which was forfeited would serve as compensation from the operator to the public for damage created. This system would be preferable to the current legislation which still allows some of the costs of mining to be transferred to other affected parties.

There is, as we have indicated, some potential overlap between the Kentucky surface mining regulations, which require that off-site damages be controlled, and the federal water quality regulations which will eventually be enforced under the 1972 act. In keeping with the approach suggested above, it seems appropriate that control of nonpoint water discharges from surface mines during mining and maintenance of holding ponds for run-off should be related to the return of the bond. Failure to control off-site damages would result in partial forfeiture of the bond according to a predetermined schedule based on the value of damages caused. It would be conceptually simple to establish a charge system for discharge of water; the cost of the discharge permit would be based on the quantity of pollutants discharged and the per unit value of damage caused. A rational operator would discharge pollutants only when the costs of control or abatement exceed the costs of the permits; in these cases the income from sale of permits could be viewed as compensation for the affected public.

In summary, we are suggesting that as more and better information on the economic value of environmental damages caused by surface mining becomes available, current regulatory approaches be modified to approach charge systems in order to take advantage of the desirable efficiency and equitable characteristics inherent in charge systems.

V. CONCLUDING COMMENTS

Coal mining is a significant contributor to gross national product and national employment, and often the major contributor to local income and employment in the regions in which it operates. The United States seems likely to become more reliant on coal as a source of energy in the future. The industry has a substantial impact on the regions in which it operates: economically, socially, and environmentally.

Laws and regulations provide much of the structure of incentives which guide the economic, social, and environmental performance of economic units. Thus, it is well to establish laws and regulations which guide economic activities in the direction of efficiency and maximum social welfare. Our focus has been narrow: the coal surface mining industry and its environmental impact. A broader focus would have necessitated discussion of labor regulations, health and safety regulations, severance taxation, and taxation of mineral reserves in the context of the coal industry. Under our approach, a solution of the environmental problems created by the surface mining industry should not be punitive. Rather, there should be a legislative and regulatory environment in which the industry continues to operate profitably and productively while internalizing the externalities it creates.

In this spirit regulatory policies ought to move, gradually and cautiously as more reliable economic information becomes available, toward a system of charges for damage created. These kinds of systems provide continuing incentives for reduction of environmental damages and require the industry to compensate the public for that damage which remains, while leaving the industry free to develop and implement the most cost-effective methods of damage abatement.

